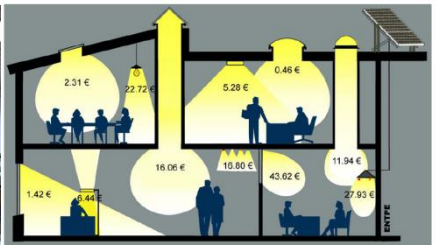
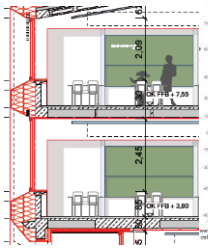
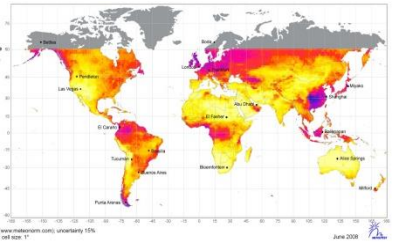
IEA SHC Task 50: Advanced lighting solutions for retrofitting buildings

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Lighting Retrofit Adviser (LRA)

28.9.2015

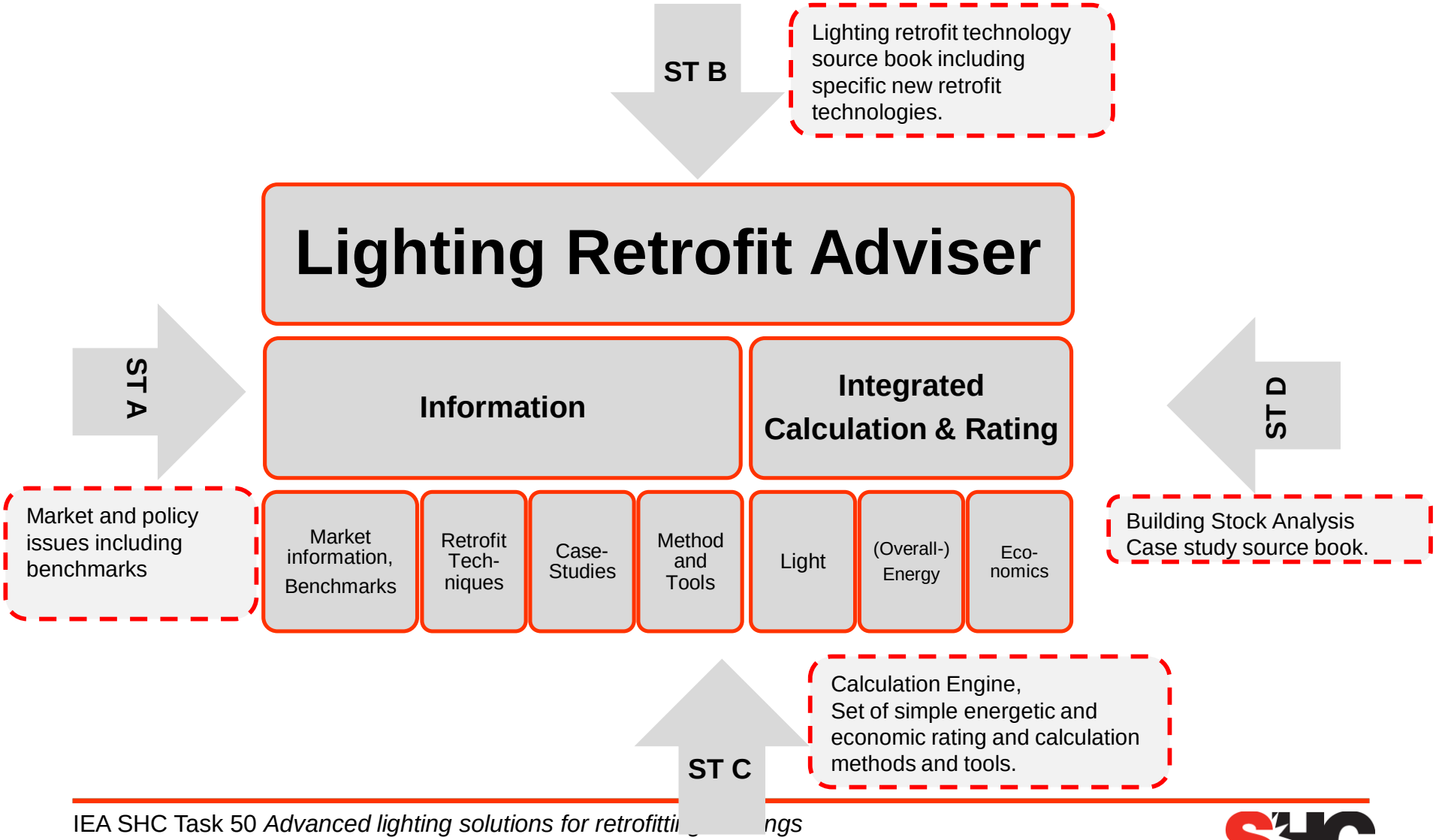
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Lighting Retrofit Adviser

Objective: Develop as a joint activity an electronic interactive source book including design inspirations, design advice, decision tools and design tools

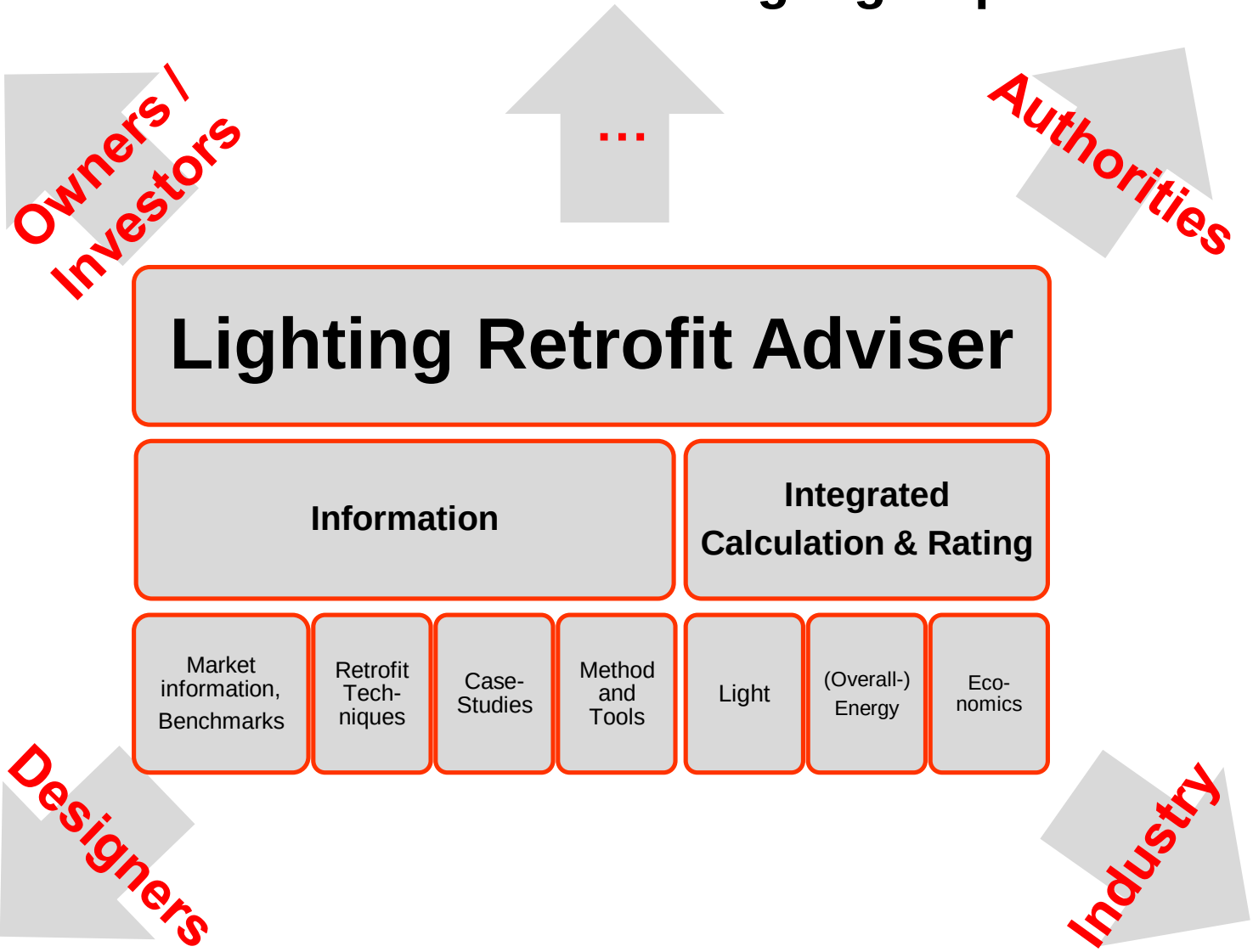
- Key role in Dissemination of Task results
- Collects and combines input the sub tasks
- Available for different mobile platforms

Lighting Retrofit Adviser: Link with other subtasks



SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Provide tailored information to target groups



Lighting Retrofit Adviser

design inspiration, design advice, decision and design tools for relighting

Information Components:

Benchmarking | Technology Consultant | Case Studies | FAQ | Markets & Policies | Loans and Subsidies | Legal Frameworks

Calculation & Rating Components:

Collection of Tools | Portfolio Analysis

Lighting Retrofit Adviser

Your are a: Owner/Investor | Continue

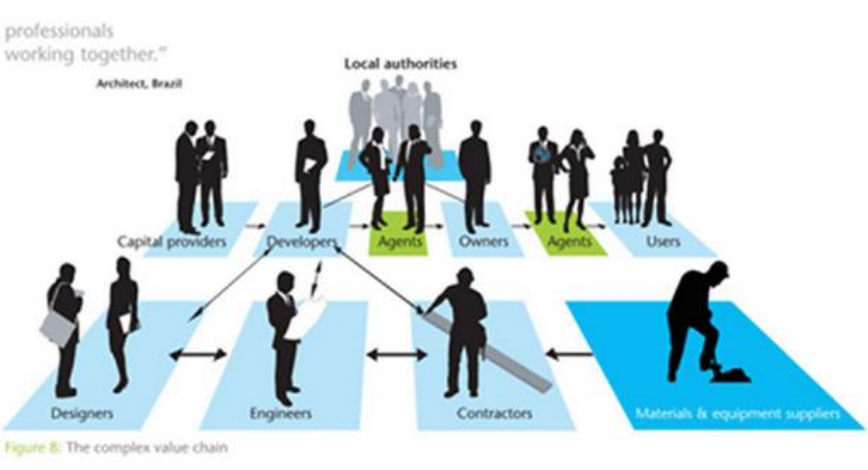


Figure 8: The complex value chain

Role Of Lighting → **Learn about Retrofit Potentials** → **Identify the potentials of your building(portfolio)** → **Initialize potential allocation**

Lighting Retrofit Adviser

Your are a: Designer / Consultant

Continue

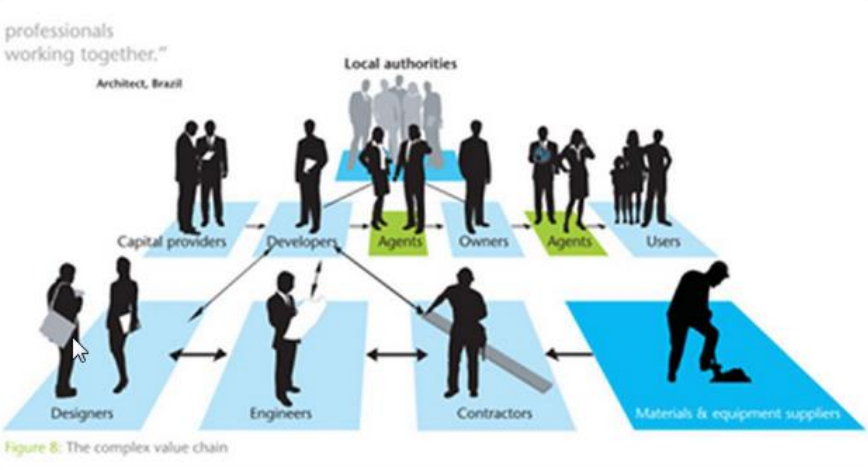


Figure 8: The complex value chain

Lighting retrofit as part of your service

Aquire specific knowledge (in a dynamic environment)

Apply and optimize services

...

Role Of Lighting

Learn about Retrofit Potentials

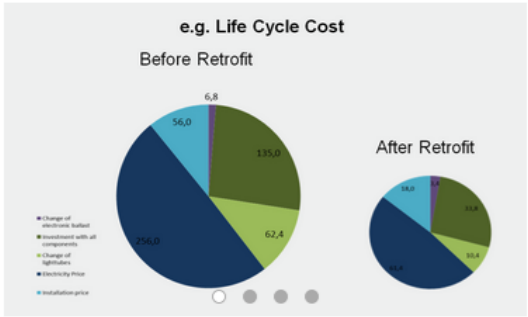
Identify the potentials of your building(portfolio)

Initialize potential allocation

Learn about Retrofit Potentials

Discover what potentials (energy and added value) lie in relighting and specifically in your building (portfolio), then decide how to proceed

One morning, when Gregor Samsa woke from troubled dreams, he found himself transformed in his bed into a horrible vermin. He lay on his armour-like back, and if he lifted his head a little he could see his brown belly, slightly domed and divided by arches into stiff sections. The bedding was hardly able to cover it and seemed ready to slide off any moment.



" **Additional information can be found here**

E.g. Subtask reports...

Suited Tools

Benchmarking

Technology Consultant

Case Studies

FAQ

Markets & Policies

Loans and Subsidies

Legal Frameworks

Fraunhofer IBP

Role Of Lighting

Learn about Retrofit Potentials

Identify the potentials of your building(portfolio)

Initialize potential allocation

Learn about Retrofit Potentials

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		Frequency of retrofit (electric)	Cost of retrofit (lighting alone)	Cost of retrofit (all inclusive)	Benefits
1.	Offices	20 - 30 yrs	40 €/m² See various options	500 €/m²	800 €/m² (value) [ref] % of 4000 €/m² .yr (productivity) [ref]
2.	Schools	30 yrs	20 €/m²	€/m²	€/m² (value) €/m² (efficiency of education)
3.	Industrial buildings	30 yrs	20 €/m²	€/m²	200 €/m² (value) [ref] % of 1000 €/m² .yr (productivity) [ref]
4.	Appartments	50 yrs (electricity)	80 €/m²	900 €/m²	1200 €/m²
5.	Shops	8 yrs	120 €/m² See various options	1000 €/m²	400 €/m² .yr (income)
6.	Supermarket	15 years			
7.					

" **Additional information can be found here**

E.g. Subtask reports...

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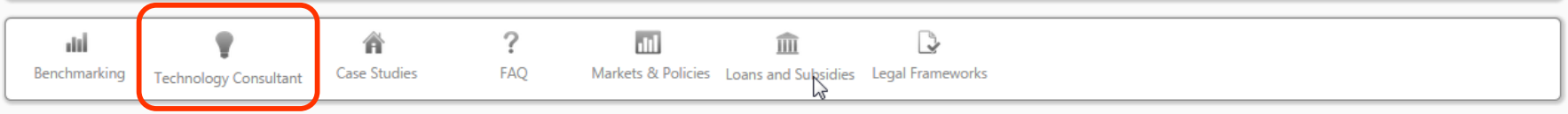
Information Components:



Calculation & Rating Components:

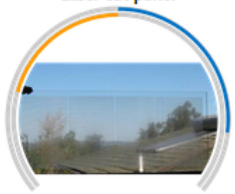
Technology Consultant

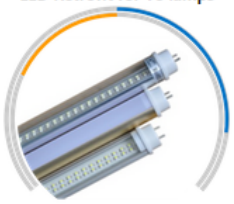
State your preferences:

Energy Efficiency:	Lighting Quality:	Thermal impact:	Costs:	Climate:
Not Important	Not Important	Impact unimportant	Not important	Not important

See the solutions:

Daylighting		Electric Lighting		Building Interior
control system	product	control system	product	
Electrochromic glazing	Laser cut panel	Occupancy control	LED Retrofit for T8 lamps	





Technology Consultant

State your preferences:

Energy Efficiency:	Lighting Quality:	Thermal impact:	Costs:	Climate:
Not Important	Not Important	Impact unimportant	Not important	Sunny

See the solutions:

Daylighting		Electric Lighting		Building Interior
control system	product	control system	product	

Electrochromic glazing

Laser cut panel

Electrochromic glazing

a coating on the inner surface of the outer pane allows the glass to change transmittance in response to a small applied voltage. Spectral selective transmittance results in a rejection of solar heat gains while admitting daylight.

Evaluation:

- Energy Efficiency
- Lighting Quality
- Thermal Impact
- Costs

Highlights:

- Preserve outward view while modulating transmitted light, glare and solar heat gains
- Energy savings due to reduced demand for electric lighting, heating and cooling
- No glare protection for direct sunlight
- High initial costs (installation and investment)

Performance of electrochromic glazing

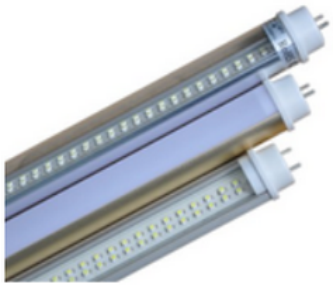
Low-voltage power is required to switch electrochromic (EC) windows, for some types a small applied voltage is needed to keep the EC in a constant state, irrespective of the level of tint. Average daily power consumption for switching and maintaining steady state for a 12-hour day is about 0,03 – 0,07 W/ft^2 floor area. The EC window can be operated automatically or manually to control light penetration, without compromising the view out. By providing unobtrusive dynamic shading in this way, EC glazing has significant potential to improve daylighting and energy use in new and existing buildings. A shift in spectral distribution might take place if all windows are equipped with EC glazing, design guidelines should be followed to maintain neutral daylight (see references). The visible transmittance (tD65)and solar heat gain coefficient (SHGC) range of EC coatings vary depending on the material composition. U-factor is not affected by the change in tint.

Significant lighting energy savings potential is achievable when the window is zoned and controlled properly. Average daily lighting energy savings in a private south-facing office in Berkeley, California were 10 – 23% given non-optimized glare / daylight control, compared to a conventional high-transmittance window (tD65 = 0,60) with a fully – lowered, slightly open venetian blind (comparable level of glare control to EC window) with the same daylighting control system. Savings of 44% are attained if the reference case has no daylighting controls.

Typically limited sizes and shapes are available, to keep costs down. EC glass cannot be installed in existing window frames. EC glass must be part of a sealed insulating glass unit assembly.

To be applied when solar heat gains need to be reduced, while allowing a view out and daylight contribution.

IEA SHC Task 21 / ECBCS Annex 29 (2000): Daylight in Buildings, A Source Book on Daylighting Systems and Components.
R. Kelly et al. (2013) Retrofit electrochromic glazing in an open plan office: a case study
Lawrence Berkeley National Laboratory (2006) Advancement of electrochromic windows
A. Azens (2003) Electrochromic smart windows: energy efficiency and device aspects
Saint Gobain (2014) How to Maintain Neutral Daylight Illumination with SageGlass® Electrochromic Glazing



LED Retrofit for T8
are applied to replace fluorescent lighting solutions, to reduce energy consumption and to increase lifetime of the lighting solution. LED retrofit lamps have the size of the conventional light source and typically include a ballast.

Evaluation:
- Energy Efficiency
- Lighting Quality
- Thermal Impact
- Costs

Highlights:
- Reduced maintenance due to long life time
- Moderate energy savings
- Possibly weak on lumen output
- Smaller beam angle can lead to darker walls and ceiling, affecting room appearance negatively

Performance of LED Retrofit for T8 lamps
The majority of LED Retrofit for T8 lamps are slightly more energy efficient (up to 105 lm/W) than the T8 fluorescent lamps. The required luminous flux is typically lower, as the beam angle of the light source is smaller. Resulting, the lighting condition is more efficient in illuminating horizontal planes, positively affecting the energy consumption. In some cases, this can lead to a lower light contribution to the vertical planes, which can effect lighting quality (darker walls and ceiling).
Most retrofit lamps have a colour rendering index above 80. Some products are weak in the red part of the spectrum. Additional information on the performance on red tones (e.g. colour rendering index R9) can give a better insight into the lamp performance. A review of available LED retrofit lamps indicates that some products still have an insufficient luminous flux or colour rendering index. Lamps with a clearly visible line of single LEDs seem to induce more glare than the conventional fluorescent lamps.
The lifetime of the retrofit lamps is typically longer (30 000 – 50 000 h), which will reduce the maintenance costs.
Retrofit can be done by a quick replacement of the lamp. In most cases, the LED retrofit lamp includes a ballast (internal converter). The ballast of the fluorescent lighting solution needs to be disconnected and the retrofit lamp can be placed directly in the lamp holder (follow the mounting instructions and pay attention that the starter of the convertor is bypassed). Other solutions have an external converter. In this a complete retrofit of the lamp with ballast is required. The replacement of the old lamp and ballast might require additional installation time.

To be used when an simple retrofit is required and low maintenance and life time are important. Lighting quality could be slightly reduced.

Myer M.A., Paget, M.L., Lingard , R.D. (2009) CALiper Benchmark Report - Performance of T12 and T8 Flourescent Lamps and Troffers and LED Linear Replacement Lamps
Ryckaert, W.R.et al. (2011): Performance of LED linear replacement lamps.

Ryckaert, W.R.; Smet, K.A.G.; Roelandts, I.A.A.; van Gils, M.; Hanselaer, P. (2012): Linear LED tubes versus fluorescent lamps: An evaluation.

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design inspiration, design advice, decision and design tools for relighting

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Navigation

Building

Building description

Daylighting

Electric lighting

User assessment

Expert evaluation

Navigation between rooms

Select...

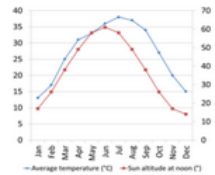
Description of the lighting and/or daylighting retrofit

This text presents a description of the lighting and/or daylighting retrofit explaining the purpose of the project and the main features of the retrofit project. This text presents a description of the lighting and/or daylighting retrofit explaining the purpose of the project and the main features of the retrofit project. This text presents a description of the lighting and/or daylighting retrofit explaining the purpose of the project and the main features of the retrofit project. This text presents a description of the lighting and/or daylighting retrofit explaining the purpose of the pro

Key statements:

- **Reduce operation costs**
- **Improve lighting quality**
- **Improve organisation's image**
- **Obtain environmental credits**
- **General refurbishment of the building**
- **Change in the organisation structure**

Media



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Navigation

Building
Building description
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Navigation between rooms

Select...

Electric lighting

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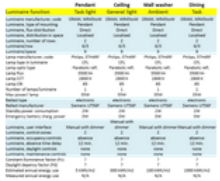
Key statements:

- **Suspended task lamps**
- **Absence detectors**
- **LED**
- **No integration with daylighting**

Media



Case Studies

Navigation

Building

Building descri

Daylighting

Electric lighting

User assessmen

Expert evaluati

Images

Hide popup

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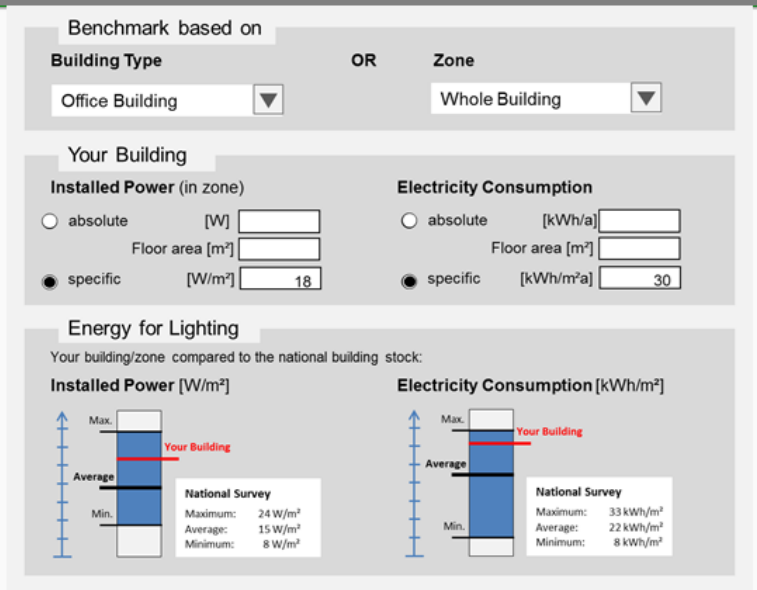


Building Type
OR
Zone

- Installed Power (in zone)

Portfolio

To analyze a portfolio of several buildings, click on the respective building types and add the information you can provide


Hospital


School


Office B.

PORTFOLIO: **„Production & Sale“**

Type	#	Floor Area [m²]	Zone Infos	Ø Age of Instal-lation
Factory				


Factory


Trade

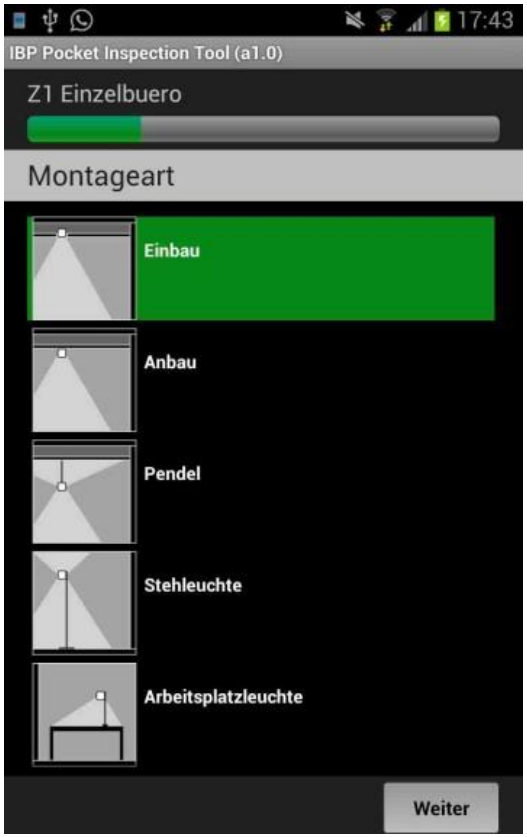

Storage

Lighting Energy Assessment

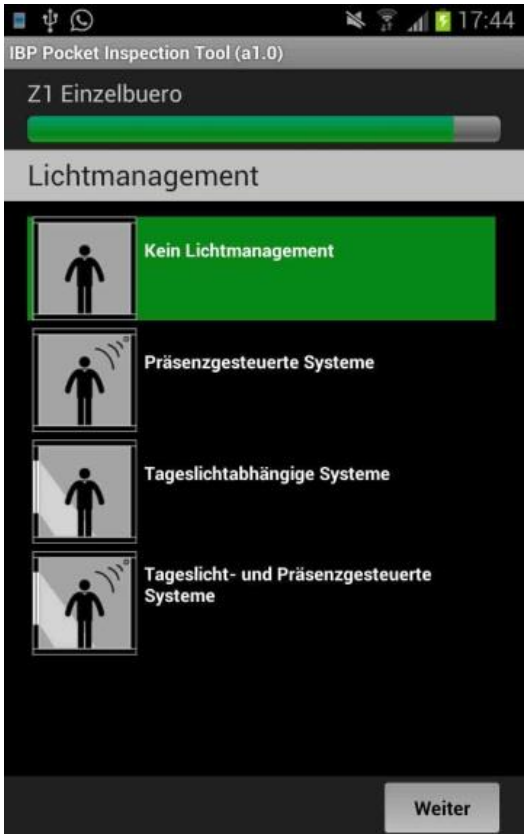
Electricity Consumption for Lighting within the Portfolio [kWh/m²]

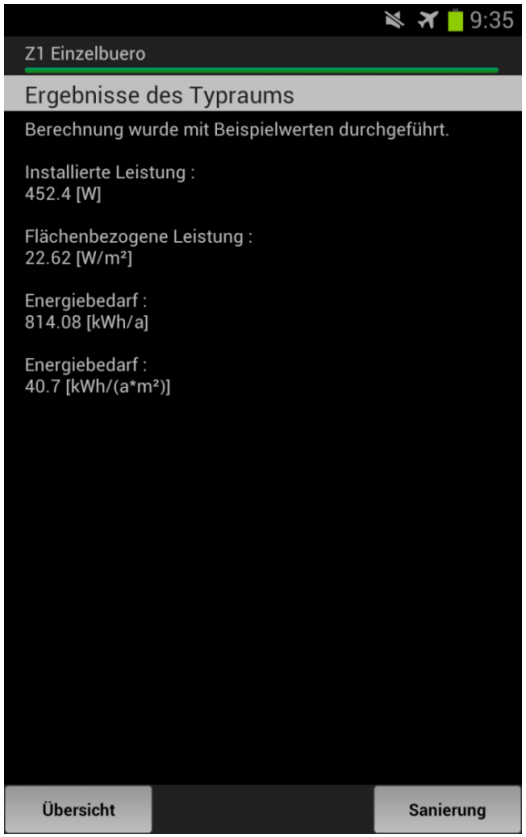
Adapted data from national survey

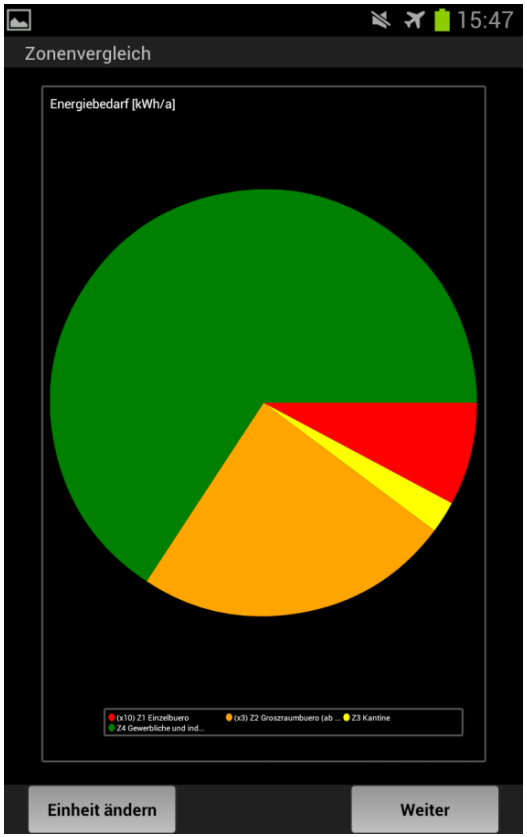
Maximum:	W/m²
Average:	W/m²
Minimum:	W/m²

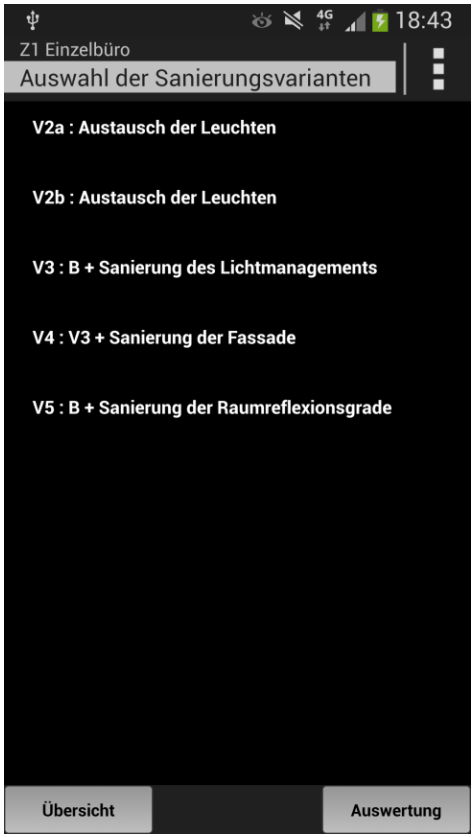

17:43
IBP Pocket Inspection Tool (a1.0)
Z1 Einzelbuero
Montageart
Einbau
Anbau
Pendel
Stehleuchte
Arbeitsplatzleuchte
Weiter

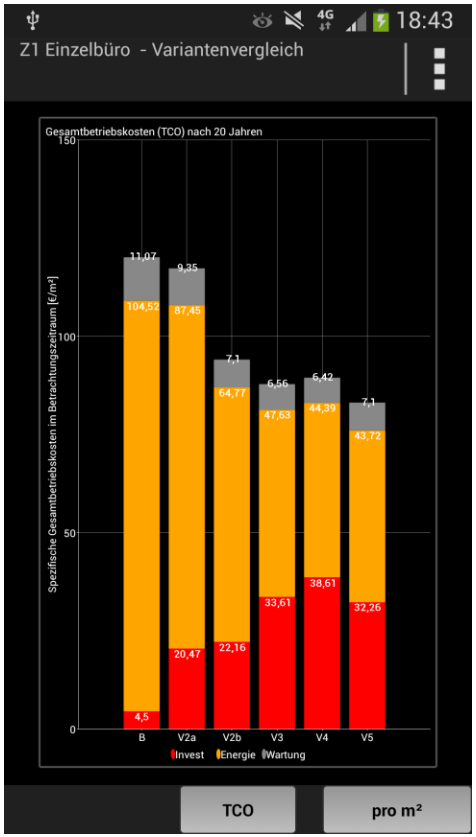

15:26
IBP Pocket Inspection Tool (a1.0)
Z1 Einzelbuero
Lampen-Typ
Leuchtstofflampe T12
Leuchtstofflampe T5
Kompaktleuchtstofflampe
Halogenlampe
Energiesparlampe
Weiter

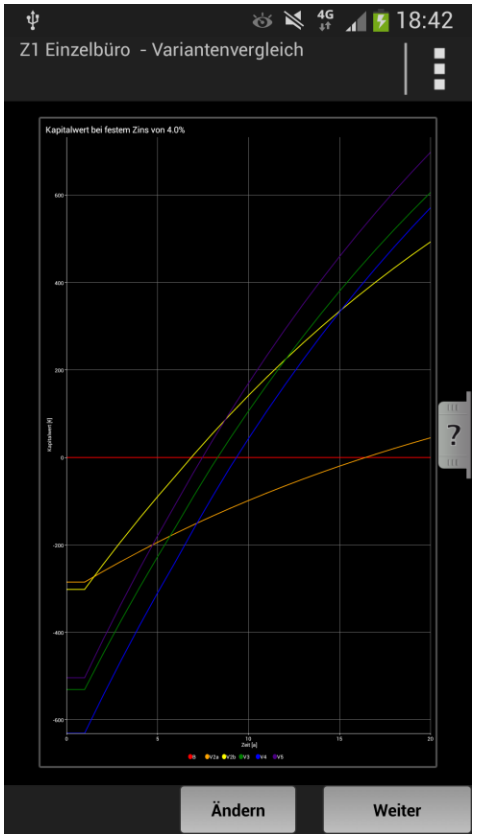

17:44
IBP Pocket Inspection Tool (a1.0)
Z1 Einzelbuero
Lichtmanagement
Kein Lichtmanagement
Präsenzgesteuerte Systeme
Tageslichtabhängige Systeme
Tageslicht- und Präsenzgesteuerte Systeme
Weiter


9:35
Z1 Einzelbuero
Ergebnisse des Typraums
Berechnung wurde mit Beispielwerten durchgeführt.
Installierte Leistung :
452.4 [W]
Flächenbezogene Leistung :
22.62 [W/m²]
Energiebedarf :
814.08 [kWh/a]
Energiebedarf :
40.7 [kWh/(a*m²)]
Übersicht
Sanierung


15:47
Zonenvergleich
Energiebedarf [kWh/a]
(x10) Z1 Einzelbuero
(x3) Z2 Groszraumbuero (ab ...
Z3 Kantine
Z4 Gewerbliche und ind...
Einheit ändern
Weiter


18:43
Z1 Einzelbüro
Auswahl der Sanierungsvarianten
V2a : Austausch der Leuchten
V2b : Austausch der Leuchten
V3 : B + Sanierung des Lichtmanagements
V4 : V3 + Sanierung der Fassade
V5 : B + Sanierung der Raumreflexionsgrade
Übersicht
Auswertung


18:43
Z1 Einzelbüro - Variantenvergleich
Gesamtbetriebskosten (TCO) nach 20 Jahren
Spezifische Gesamtbetriebskosten im Betrachtungszeitraum [€/m²]
150
100
50
0
11,07
9,35
7,1
6,56
6,42
7,1
104,52
87,45
64,77
47,63
44,39
43,72
4,5
20,47
22,16
33,61
38,61
32,26
B
V2a
V2b
V3
V4
V5
Invest
Energie
Wartung
TCO
pro m²


18:42
Z1 Einzelbüro - Variantenvergleich
Kapitalwert bei festem Zins von 4.0%
?
Ändern
Weiter

iPhone

iPad

Android

Android Tab

Windows Phone 8

Tizen

Fraunhofer IBP

- **iPhone**
- iPad
- Android
- Android Tab
- Windows Phone 8
- Tizen

iPhone

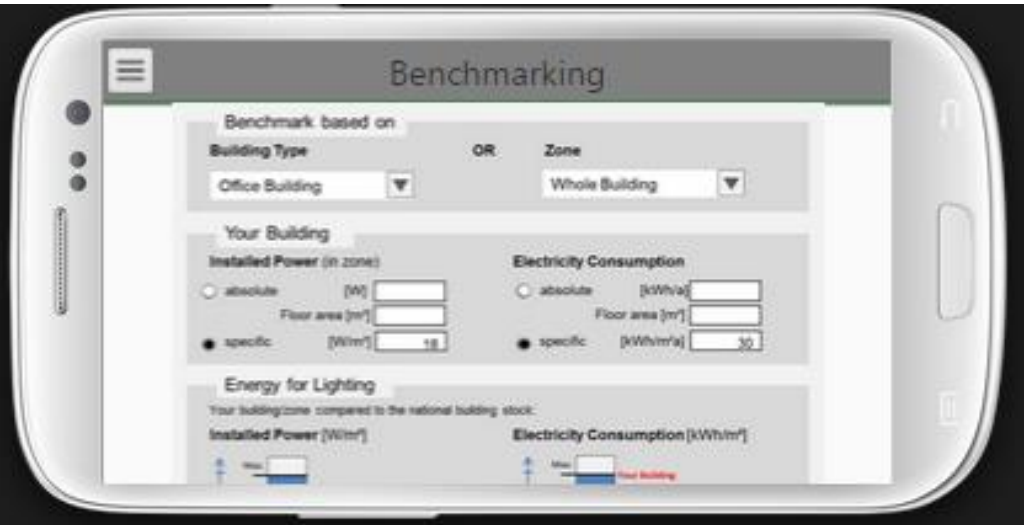
iPad

Android

Android Tab

Windows Phone 8

Tizen



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iPhone

iPad

Android

Android Tab

Windows Phone 8

Tizen

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Available in 2015

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